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CONTRIBUTIONS TO THE KNOWLEDGE OF *OLLA* CASEY (COLEOPTERA: COCCINELLIDAE: COCCINELLINI): NEW SPECIES FROM THE GALAPAGOS ISLANDS, UPDATES ON THE DISTRIBUTION OF *O. V-NIGRUM* (MULSANT)

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Abstract.—***Olla lacrimosa*, n. sp.**, is described from Isabela Island of the Galapagos Archipelago. Earlier, the single known example of this species was mistaken for *Olla hageni* Vandenberg, a closely related species which occurs on the neighboring island of Santa Cruz. A diagnosis, habitus drawing, and key details of the anatomy and morphology of the new species are provided and compared to related members of the genus. The habits and distribution of the genus are reviewed, and updated distributional data are provided for *O. v-nigrum* Mulsant, a widespread species of temperate and tropical America which has been released in a number of countries for biological control purposes.

Key Words: *Olla*, Coccinellini, new species, taxonomy, biological control, distribution, Galapagos

With the addition of the single new species described herein, the New World genus *Olla* Casey (Coleoptera; Coccinellidae; Coccinellini) contains five known species, two of which are endemic to islands of the Galapagos Archipelago (Santa Cruz Island, Isabela Island). *Olla* was last revised by Vandenberg (1992) who described three new species, reviewed the taxonomic and nomenclatural history, and provided prey / habitat associations and distributional data, along with hypotheses of specific and higher affinities. In that work, the name *Olla hageni* Vandenberg was assigned to a species collected on Santa Cruz Island, but also incorrectly applied to a single specimen collected from Isabela Island, recognized here as a distinct, but closely related species. The present contribution to the genus was undertaken in order to make the new species name available for a book on the Coleoptera of the Galapagos Islands being prepared by Stewart Peck, Carleton University, Ottawa, and to provide updated information on the distribution of the genus and its use in natural and biological control.

Olla is endemic to the New World, with a natural range extending from southeastern Canada to Argentina, the West Indies, and Galapagos Archipelago. These lady beetles are primarily arboreal or bush-inhabiting and feed on a variety of soft-bodied insects, including aphids, psyllids, whiteflies, and thrips. As such, they have been considered a major component in the natural control of pest insects in commercial nut groves and fruit orchards (Bugg and Dutcher 1989, 1993; Goonewardene et al. 1989; Carroll and Hoyt 1984; Horsburgh and Asquith 1968; Putman 1964).

The present distribution of the genus has been altered drastically due to the activities of man. Early biological control efforts resulted in the establishment of *Olla v-nigrum* (Mulsant) in Hawaii and Guam (Timberlake 1943, Chapin 1965, Gordon 1985). According to internet resources (Sarrailh et al. 1996, Centre de Coopération Internationale en Recherche Agronomique pour le Développement—Département des productions fruitières et horticoles (CIRAD-Flhor), Stations de la Réunion 1995), recent attempts to control the Leucaena psyllid, *Heteropsylla cubana,* have led to the introduction of *O. v-nigrum* in a number of Asian and Pacific countries, with recent redistribution and establishment in New Caledonia and Reunion Island. Sasaji (1992) records the presence of *O. v-nigrum* in Japan (particularly Okinawa Prefecture), with the earliest collection date in 1987. Kreiter and Iperti (1984) propose the release of this species in southeastern France for control of aphids on peach trees, and further document releases in Israel and former Czechoslovakia; the current status of *O. v-nigrum* in these countries is unknown.

The introduction of other exotic species into North America has apparently had both positive and negative impacts on the presence of *O. v-nigrum.* This predator, once relatively rare in Florida, became common following the invasion of the Asian citrus psyllid, *Diaphorini citri* Kuwayama, in citrus groves throughout the state (Michaud 2001, 2002). In contrast, *O. v-nigrum* has apparently become less prominent in certain fruit and nut crops in North America following the introduction of the multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) (Brown and Miller 1998, Rice et al. 1998), which also has a broad prey range and predilection for arboreal habitats. The recent spread of *H. axyridis* into Argentina and Brazil (Saini in press, Almeida and Silva 2002) may further impact population levels of *O. v-nigrum* where the two species compete for similar resources in the southernmost part of *Olla*'s range.

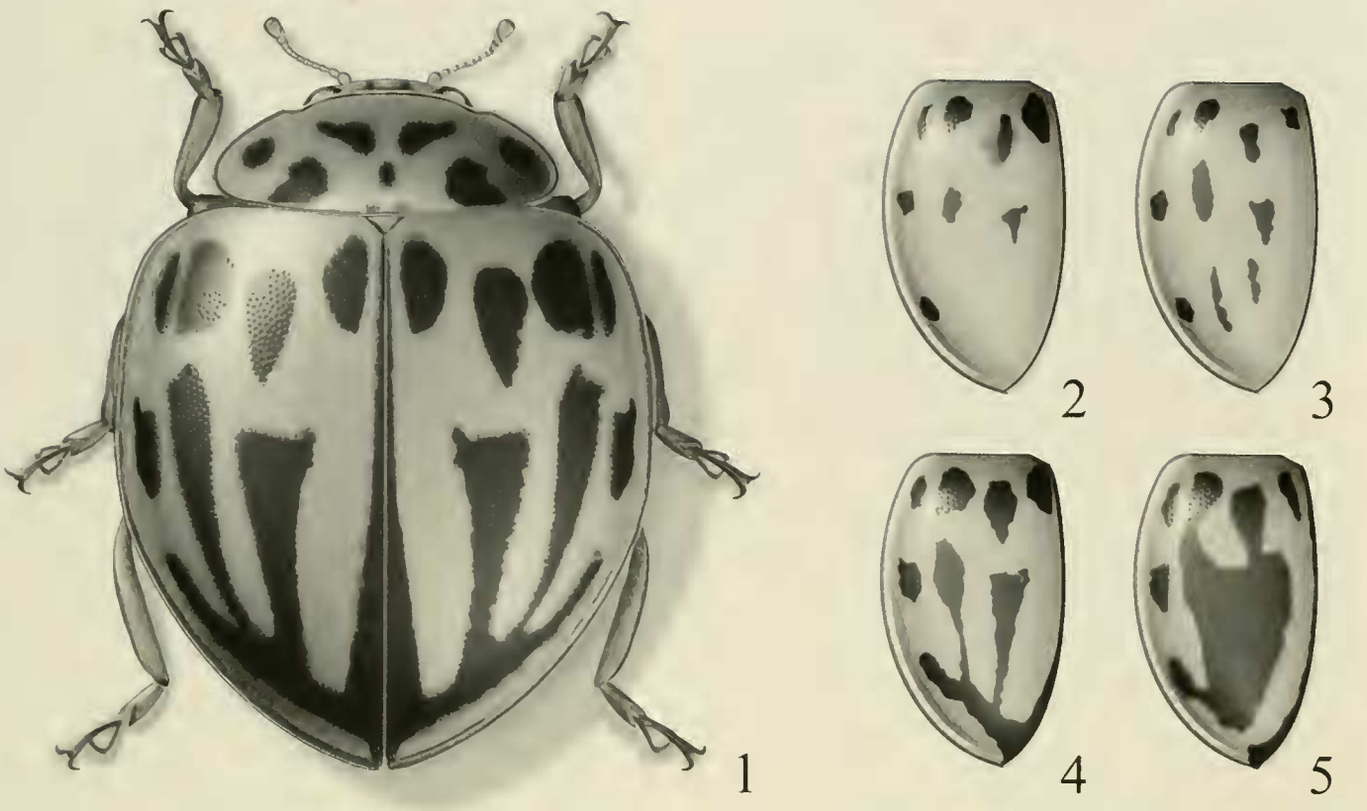
Acronyms for collections mentioned in the text are:

CAS California Academy of Sciences, San Francisco.
CMNC Canadian Museum of Nature Collection, Ottawa.
USNM National Museum of Natural History, Washington, D.C.

Olla lacrimosa Vandenberg, new species
(Figs. 1–5, 7, 9, 11)

Olla hageni: Vandenberg 1992 (misidentification of single specimen from type series of *Adalia galapagoensis* Van Dyke).
Adalia galapagoensis Van Dyke 1953 (in part).

Diagnosis.—Distinguished from other species in the genus by the form of the sipho of the male genitalia which has the apical flagellum distinctly longer (~1.4×) than the declinate subapical projection, but much less than three times as long (Fig. 7), and by the tendency for the elytral maculae to form dark brown streaks against a yellow background (Figs. 1, 3–4). It can be further distinguished from *Olla hageni,* the only other species of *Olla* known from the Galapagos Islands, by the pair of median carinae on the intercoxal process of the prosternum (Figs. 13–14). *Olla lacrimosa* is most likely to be confused with *Cycloneda galapagoensis* (formerly in *Adalia*), which may exhibit a similar streaked elytral pattern. *Cycloneda galapagoensis* differs in having the metepisternum black and mesepimeron white (both cream colored in *O. lacrimosa*), and the head entirely black, or pale with a basal transverse to triangular black mark (yellow with a pair of brown to black basal spots in *O. lacrimosa*). The genitalia of *C. galapagoensis* are of an entirely different form (Vandenberg 1992, 2002), with an undivided apex to the male basal lobe, and a well developed infundibulum of the female sperm duct. Although *C. galapagoensis* is listed as occurring on both Floreana and Isabela Islands (Van Dyke 1953) the latter record is the result of a misiden-

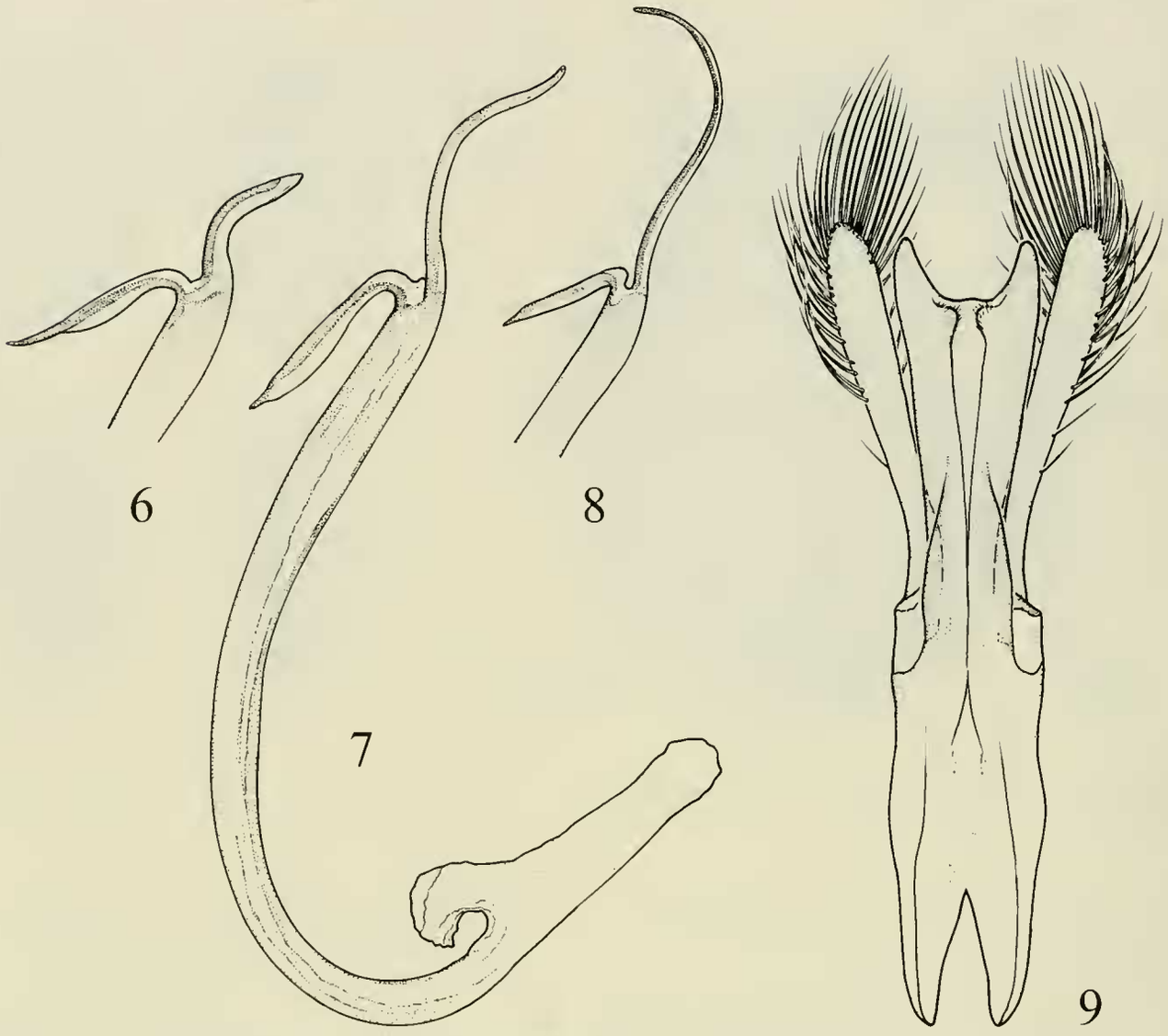


Figs. 1–5. *Olla lacrimosa*. 1, Habitus of Holotype (male). 2–5, Left elytron of selected individuals, showing a range of color patterns.

tification (see "other material examined," below)

Description of holotype (male).—Length 5.0 mm; width 4.0 mm. Form subogival, moderately convex with elytral and pronotal margins feebly explanate. Surface between elytral punctures highly polished to weakly shagreened, between head and pronotal punctures distinctly shagreened. Dorsal color pattern (Figs. 1, 4) consisting of dark brown spots and streaks on light yellow background. Head with pair of rounded dark brown spots near base and faint stippled row extending anteriorly from each; clypeus and labrum light golden brown. Pronotum with five dark brown marks forming a broken M rooted at pronotal base and occupying median three-fifths; pair of well-developed rounded dark brown spots centered one within each lateral third; additional pair of minute, more ruddy dots faintly indicated at base just in front of scutellum. Elytral suture and scutellar margins dark brown. Each elytron with four discrete irregular dark brown marks in staggered row across basal one-fourth, sutural and lateral spots closely approaching but not touching respective margins; single discrete spot near lateral margin centered just in front of middle; remaining marks forming a dendrogram rooted at elytral apex, with tapered sutural branch, abbreviated lateral branch and two medium length inner branches as shown (Fig. 4). Elytral punctures each marked with pinpoint of brown. Ground color of ventral surface including appendages light golden brown; mesepisternum slightly darkened at middle; mesepimeron, metepisternum, metepimeron cream colored; metasternum except intercoxal process and outermost margins dark brown; abdominal ventrites 1–5 dappled with dark brown; pronotal hypomeron and elytral epipleuron same color as elytron.

Eyes with inner orbits roughly parallel, separated by about twice diameter of eye. Intercoxal process of prosternum with pair of carinae converging just beyond midlength of prosternum (Fig. 13). Elytral epipleuron concave, descending externally, with maximum width approximately 1/6 width of body at base of abdomen. Abdo-



Figs. 6–9. Male genitalia of *Olla* species. 6–8, Siphos, right lateral view (apex at top of page). 6, *O. v-nigrum* (apex). 7, *O. lacrimosa* (holotype, whole structure). 8, *O. hageni* (apex). 9, Ventral view of phallobase, *O. lacrimosa* (holotype).

men arcuate, pointed posteriorly, with six ventrites, widest at middle of first ventrite; postcoxal line of first ventrite curved posteriad and laterad closely paralleling posterior margin for most of length, fading before attaining lateral margin; oblique line present, separated from main postcoxal arc by short break; posterior margins of ventrites 1–3 linear, of ventrites 4–5 weakly bowed anteriorly, apex of ventrite 6 exposed, obtriangular. Male genitalia with basal lobe long and slender (Figs. 9, 11), with apex consisting of two triangular denticles separated by weakly convex border; parameres simple in shape, not curving over sides of basal lobe at apex; sipho (Fig. 7) with sinuous apex (bearing median orifice) approximately 1.4x longer than declinate subapical projection; tube forming main body of sipho slender, oval in cross-section, with membranous area visible in lateral view.

Female.—Differs from male in being slightly more elongate and possessing rounder abdominal apex; ventrite 5 bowed posteriorly, covering ventrite 6. Spermatheca with curved, tapered cornu; straight, distally swollen ramus bearing small accessory gland; with minute, nipplelike nodulus communicating with sperm duct. Sperm duct flexible, attached middorsally to tubular bursa. Base of common oviduct swollen with thick rugose walls.

Variation (based on allotype and 14 paratypes).—Length 4.0–6.5 mm; width 3.2–4.2 mm. Prosternal carinae joined anteriorly

(Fig. 13) or not (Fig. 14). Elytral ground color varying from more ashen color (these appear to be teneral specimens) to light or medium yellow. Elytral maculation variable (Figs. 2–5), some specimens with apical dendritic mark as in holotype (Figs. 1, 4), but others with mark broken into detached spots and abbreviated dashlike markings (Fig. 3), or of intermediate configuration; one lightly marked individual with discrete elytral spots arranged in rows of 4–3–1 as in common form of most *Olla* species (Fig. 2); one specimen with large irregular mark formed from discal spots of all three levels (Fig. 5). Pronotum with some spots lacking or coalescent. Venter with more or less extensive areas of dark brown.

Type material.—Holotype (♂): "Ecu[ador]: Galap[agos Is.]: Isabela, Cerro Azul, 300m, 18–26.V.1991, C. Vogel, CVVCA-10-005" (CMNC). Allotype (♀): "Ecu: Galap., Isabela, 6kmNE Tagus Cove, 600m, V. Darwin, 16.V.92, arid z[one], mv. light & gen. colln, J.Cook & S.Peck 92-189" (CMNC). Paratypes (total 14): 3 with same data as allotype (USNM); 2 same as preceding except "3kmNE Tagus Cove" and final numbers "92–187" (CMNC); 4 "Ecu: Galap; Isabela, V[olcán].Wolf, 1250m, arid z, sweeping, 20.V.96, S.Peck, 96–200" (CMNC); 1 "Ecu: Galap; Isabela, V.Wolf, 750–1000m, arid forest sweeping, 22.V.96, S.Peck, 96–203" (CMNC); 1 "Ecu: Galap; Isabela, V.Wolf, arid z, 1500m, sweeping shrubs, 21.V.96, S.Peck, 96-202" (CMNC); 1 "Ecu: Galap; Isabela, Sierra Negra, 900m, 5.IV.96, pampa sweeps, S.Peck, 96-80" (CMNC); 1 "Ecu: Galap; Isabela, Sierra Negra, 1000m, 6.IV.96, pampa sweeps, S.Peck, 96-85" (USNM); 1 "Ecu: Galap: Isabela, Volcan Alcedo, Crater Rim, 1100m, 21.23.VI.1991, C. Vogel, CVALC-15-003" (CMNC).

Other material examined.—Paratype (♀?) of *Adalia galapagoensis* Van Dyke (1953): "Albemarle, Galapagos Is./500 ft, VIII-1906/ coll. by J. R. Slevin/ PARATYPE, Adalia galapagoensis, E. C. Van Dyke" (CAS). The type series of *Adalia galapagoensis* consists of 22 specimens. All of these were collected on Floreana Island with the exception of the single misidentified paratype (above) which was collected on Isabela (= Albemarle). This specimen is the most lightly marked example of the new species that I have encountered, with elytral markings similar to Fig. 2, but with the sutural and lateral spot of the first row, middle spot of the second row, and apical most spot lacking or indistinct.

Etymology.—From the Latin *lacrimosus* meaning "prone to tears or crying," the name is a reference to the elytral markings which appear to have streaked and run down the beetle's back in the manner of oldfashioned mascara.

Discussion.—The male genitalia of *Olla lacrimosa* has a siphonal apex (Fig. 7) which is intermediate in development to the elongate whiplike apex found in *O. hageni* (Fig. 8) and the shorter more robust apex of *O. v-nigrum* (Fig. 6; see also Vandenberg 1992 for variation within the latter species). Similarly, the basal lobe of *O. lacrimosa* (Fig. 11) is intermediate in form between the distally expanded wedgeshaped structure found in *O. v-nigrum* (Fig. 10) and the more slender, nearly parallelsided basal lobe of *O. hageni* (Fig. 12); the distal denticles of the basal lobe are also of intermediate shape and width in the new species. No significant differences were observed in the female genitalia of *O. lacrimosa* and *O. hageni* (see Vandenberg 1992 for illustration), although differences in the membranous portions of the female tract are more difficult to assess. The prosternal intercoxal process of *O. lacrimosa* (Figs. 13–14) has a pair of median carinae as in *O. v-nigrum*; in *O. hageni* (Fig. 15) the carinae are abbreviated and displaced laterally so that they are juxtaposed above the clear amber edge of the process, forming a marginal bead. A yellow dorsal ground coloration is common to both *O. lacrimosa* and *O. hageni*, although less developed in teneral specimens of the former; in *O. v-ni-*

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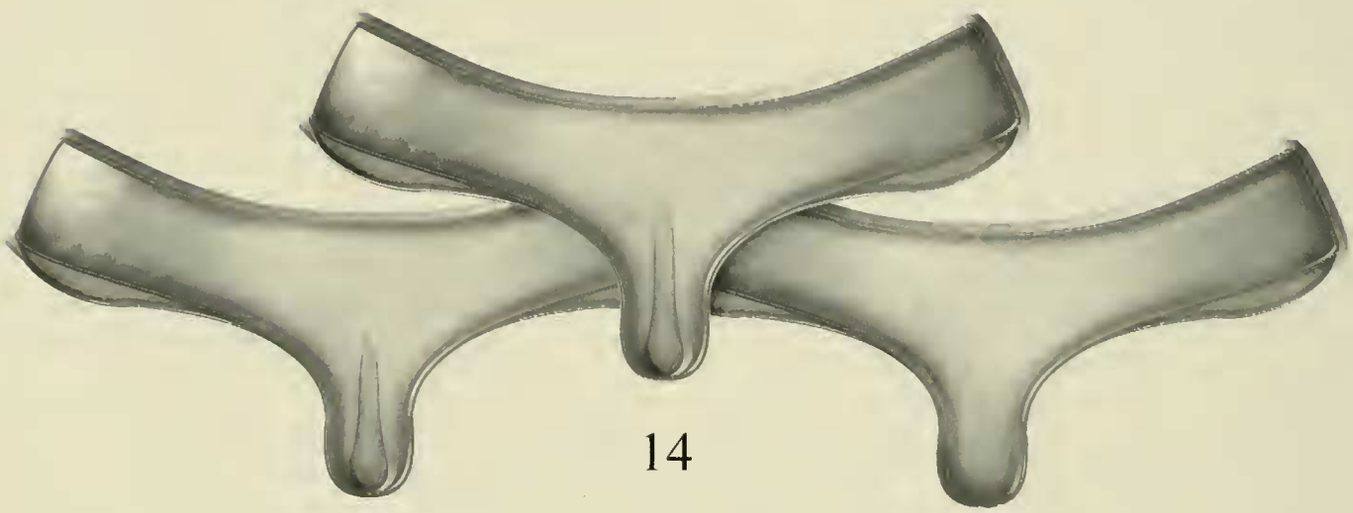

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Figs. 10–15. Key structures for differentiating *Olla* species. 10–12, Basal lobes of male genitalia. 10, *O. v-nigrum*. 11, *O. lacrimosa* (holotype). 12, *O. hageni*. 13–15, Prosterna. 13, *O. lacrimosa* (drawing of holotype). 14, *O. lacrimosa* (alternative configuration of carinae). 15, *O. hageni*.

grum the ground color of the pale form is ashy gray or a drab beige.

A close relationship between *O. hageni* and *O. v-nigrum* was demonstrated by the formation of hybrid embryos in laboratory crosses (Vandenberg 1992), and is further supported by similarities in the genitalia of both sexes. Vandenberg (1992) provided a cladistic analysis of the 4 species of *Olla* known at that time, and hypothesized that *O. hageni* is a relatively young species, derived from a founding population of the widespread continental *O. v-nigrum* less than 3 or 4 million years ago, and modified through genetic drift and the unique selection pressures of the new island habitat. The discovery of *O. lacrimosa* on a neighboring island suggests that the evolution of *O. hag-*

eni involved an intermediate step comprising an additional speciation event preceded by dispersal within the archipelago. Common trends found only in the two galapagan species which imply that they share a very recent ancestry and sister group relationship include the elongation of the siphonal apex of the male genitalia, reduction/loss of the median convexity at the apex of the basal lobe, and possession of a relatively saturated yellow ground coloration of the head, pronotum, and elytron. The essentially identical form of the female genitalia further supports the idea of a very recent divergence of the two island species.

Acknowledgments

I am grateful to Stewart Peck for providing the series of the new *Olla* species from Isabela Island, which has allowed me to correct my earlier misidentification of the single previously known specimen. I also thank Dave Kavanaugh (CAS), for access to type material of *Adalia galapagoensis* Van Dyke, which contains the aforementioned specimen. The present publication has benefitted from the constructive reviews of Stewart Peck; Adam Ślipiński, CSIRO Entomology, Canberra, Australia; and Dave Nickle and Al Norrbom, Systematic Entomology Laboratory (SEL), Beltsville, Md., and Washington, D.C., respectively. Elisabeth Roberts (SEL) assisted with manuscript preparation and produced the pen and ink drawings for figs. 6–9.

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